Preliminary experiments were made in order to illustrate the thermal phenomena which result from the rush of air through a single aperture. Two effects were anticipated, one of heat arising from the *vis viva* of air in rapid motion, the other of cold arising from dilatation of the gas and the consequent conversion of heat into mechanical effect. The latter was exhibited by placing the bulb of a very small thermometer close to a small orifice through which dry atmospheric air, confined under a pressure of 8 atmospheres, was permitted to escape. In this case the thermometer was depressed 13° Cent. below the temperature of the bath. The former effect was exhibited by causing the stream of air as it issued from the orifice to pass in a very narrow stream between the bulb of the thermometer and a piece of gutta percha tube in which the latter was enclosed. In this experiment, with a pressure of 8 atmospheres, an elevation of temperature equal to 23° Cent. was observed. The same phenomenon was even more strikingly exhibited by pinching the rushing stream with the finger and thumb, the heat resulting therefrom being insupportable.

The varied effects thus exhibited in the "rapids" neutralize one another at a short distance from the orifice, leaving however a small cooling effect, to ascertain the law of which and its amount for various gases, the present researches have principally been instituted. A plug of cotton wool was employed, for the purpose at once of preventing the escape of thermal effect in the rapids, and of mechanical effect in the shape of sound. With this arrangement a depression of 0°·31 Cent. was observed, the temperature of the dry atmospheric air in the receiver being 14°·5 Cent., and its pressure 34·4 lbs. on the square inch, and the pressure of the atmosphere being 14·7 lbs. per square inch.

*Erratum.*—In Mr. Joule's letter to Col. Sabine, "Proceedings of the Royal Society," p. 307, line 27, *for* 2·67 *read* 0·267.

6. "On Clairaut's Theorem and Subjects connected with it." By Matthew Collins, Esq., B.A., Senior Moderator in Mathematics and Physics of Trin. Coll. Dublin. Communicated by S. Hunter Christie, Esq., M.A., Sec. R.S. &c. Received May 2, 1853.

The author begins his investigations by proving the existence of principal axes for any point of a body, which he makes to depend on the existence of principal axes of an auxiliary ellipsoid (Poinsot's central one) having its centre at the given point, and such that any semidiameter of it is reciprocally proportional to the radius of gyration of the body about that semidiameter.

He afterwards employs another ellipsoid (called M^c^Cullagh's ellipsoid of inertia) concentric to the former and reciprocal to it, which admirably suits and facilitates the remainder of his investigations, and whose characteristic property is this, that it gives the radius of gyration itself (and not its reciprocal, as in Poinsot's) about any semidiameter of it, the radius of gyration being in fact equal to the portion of that semidiameter between the centre and a tangent plane perpendicular to it.

He then proves that the attraction of a body of any shape, whose

centre of gravity is O and mass is $\mu$, on a very remote point P along PO$=d$, is $\frac{\mu}{d^2}+\frac{3}{2d^4}(A+B+C-3M)$, A, B, C being the three principal moments of inertia of the body, and M its moment about OP. And if M$^{c}$Cullagh's ellipsoid of inertia be taken having O its centre, and its principal axes coinciding in direction with the principal axes of the body at O; and if a tangent plane to this ellipsoid perpendicular to OP at P′ touch it in R, it is shown that the component of the attraction of the body $\mu$ on P in a direction perpendicular to OP is parallel to RP′, and equal to $\frac{3\mu}{d^4}\times \mathrm{OP'}\times \mathrm{P'R}$.

Next comes the proposition, "if two confocal ellipsoids attract an external point, their two resultants are coincident in direction and proportional to their masses," the truth of which is very easily inferred from Ivory's theorem. This proposition is then employed in proving that the expressions already found for the attractions of a body of *any shape* on a very remote point hold true likewise for the attractions of *an ellipsoid* (whether it be homogeneous, or only composed of concentric ellipsoidal strata having the same principal axes, and any variable but small excentricities) on any external point, whether near or remote.

To apply these reasonings to the case of the earth, the ellipsoid is then supposed to become a spheroid, and the attracted point P is supposed on its surface; then C$=$B and M$=$B $\cos^2\lambda+$A $\sin^2\lambda$, $\lambda$ being the angle OP$(=d)$ makes with the equator; and so the central attraction along PO, viz. $\frac{\mu}{d^2}+\frac{3}{2d^4}(A+B+C-3M)$, then becomes $\frac{\mu}{d^2}+\mathrm{T}(1-3\sin^2\lambda)$, where $\mathrm{T}=\frac{3}{2d^4}(A-B)$: the attraction of the spheroid on P perpendicular to PO and urging P towards the equator is also easily shown to become T $\sin 2\lambda$.

Now that the point P may be at rest, it is necessary that the tangential component of the central force acting along PO should be equal to the sum of the tangential components of the centrifugal force (acting on P perpendicular to the earth's axis), and of the force perpendicular to PO; this condition gives an equation from which Clairaut's theorem follows instanter, due regard being had to the difference of the polar and equatorial gravities as determined by the general expression $\frac{\mu}{d^2}+\mathrm{T}(1-3\sin^2\lambda)$, and the ellipticity of the exterior surface being supposed so small that its square and higher powers may be rejected.

7. "On the Change of Refrangibility of Light."—No. II. By Professor Stokes, M.A., F.R.S. Received June 16, 1853.

The principal object of this paper is to explain a mode of observation by means of which the author found that he could exhibit, with ordinary day-light, the change of refrangibility produced by substances opake as well as transparent, even when they possessed